Loop transformations to improve accuracy of sound floating-point computations
Bachelor's Thesis

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1. Project Description
Floating-point arithmetic is widely used by software developers but is unsound, i.e., there is no guarantee on the accuracy obtained. Currently, IGen [1,2] provides an automatic approach to transform numerical computations using floating-point arithmetic to equivalent sound computations using interval arithmetic (IA) and affine arithmetic (AA), i.e., returns an error bound that is guaranteed to contain the correct result of the program if it had been executed in real arithmetic. When using AA, IGen supports static analysis in loop-bodies to improve the accuracy of the final result. The effectiveness of the analysis, however, highly depends on the number of variables and computations performed in the loop body. The main objective of this project is therefore to enable loop transformations in IGen, e.g., loop unrolling, loop interchange, etc., to convert loop bodies into a suitable form for the analysis.

2. Specific Goals
- Review the related work.
- Implement loop unrolling in IGen as a first loop transformation.
- Investigate and implement other loop transformations, e.g., using the polyhedral model, that are beneficial.
- Evaluate thoroughly the performance and accuracy improvement of the approach in a relevant set of benchmarks.
- Maintainability and extendibility of the code should receive high priority.

3. Deliverables
- The source code of the implementation.
- A digital and two printed exemplars of the bachelor thesis containing a detailed description of the problem, an overview of related work and existing approaches, a description of the tool that was built, and evaluation of results.

4. Organization
- The student will have weekly or biweekly meetings with her advisors in which progress and occasional problems will be discussed.

Contact
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References